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SEC 3 ELEMENTARY MATHEMATICS

UNIT 1: QUADRATIC EQUATIONS AND FUNCTIONS

1.1 RECALL WHAT IS A QUADRATIC EQUATION

1.1 CONCEPTUAL BRIDGING: RECALL WHAT IS A QUADRATIC EQUATION

A quadratic equation is of the form

$$ax^2 + bx + c = 0$$

where a, b and c are real numbers and $a \neq 0$.

1.1 WORKED EXAMPLE 1 (SOLVING QUADRATIC EQUATIONS BY FACTORISATION)

Solve the equation $x^2 + 6x + 8 = 0$.

1.1 WORKED EXAMPLE 2 (SOLVING QUADRATIC EQUATIONS OF THE FORM $(x+a)^2 = b$)

Solve the following equations, giving your answers to 3 significant figures where necessary.

(i) $(x+2)^2 = 25$

(ii) $(x-5)^2 = 20$

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1.1 PRACTICE NOW**QUESTION 1**

Solve the following equations, giving your answers to 3 significant figures where necessary.

(i) $(3x-2)^2 = 16$

(ii) $(5-x)^2 = 7$

(iii) $\left(\frac{1}{2}x-4\right)^2 = 81$

(iv) $(2x+5)^2 = 45$

(v) $(x-5)^2 = \frac{9}{16}$

(vi) $\left(2x+\frac{3}{2}\right)^2 = \frac{81}{100}$

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1.2 SOLVING QUADRATIC EQUATION BY COMPLETING THE SQUARE

1.2 CONCEPTUAL BRIDGING: SOLVING QUADRATIC EQUATION BY COMPLETING THE SQUARE

If a quadratic equation of the form $x^2 + px + q = 0$ can be expressed into the form

$$(x+a)^2 = b,$$

then from 1.1 Worked Example 2, it can then be solved easily **by taking the square roots** on both sides of the equation to obtain the solutions.

Let's consider the expansion of $(x+5)^2$ using the multiplication frame.

\times	x	5
x	x^2	$5x$
5	$5x$	25

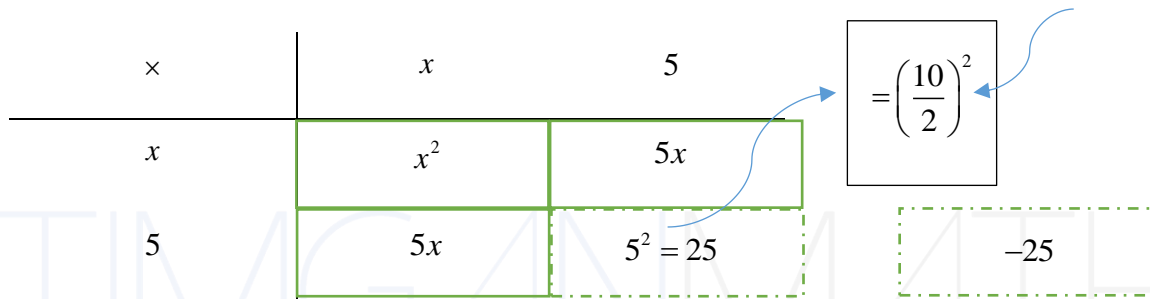
Then $(x+5)^2 = x^2 + 10x + 25$.

Note that $10x$ is formed by adding the two terms $5x$ together,

$(x+5)^2$ is a perfect square.

$x^2 + 10x$ is not a perfect square without the term, 25.

So, what number must be added to complete the square for $x^2 + 10x$?



$$x^2 + 10x = (x^2 + 10x + 25) - 25$$

$$= (x + 5)^2 - 25$$

If $x^2 + px = (x + a)^2 - b$, then $a = \frac{p}{2}$ and $b = \left(\frac{p}{2}\right)^2$. So $x^2 + px = \left(x + \frac{p}{2}\right)^2 - \left(\frac{p}{2}\right)^2$.

1.2 WORKED EXAMPLE 1 (COMPLETING THE SQUARE FOR QUADRATIC EXPRESSION $x^2 + px$)

Express each of the following expressions in the form $(x+a)^2 + b$.

(i) $x^2 + 6x$

(ii) $x^2 - 5x$

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To solve a quadratic equation of the form $x^2 + px + q = 0$, we can express it as follows:

$$x^2 + px + q = 0$$

$$\underbrace{(x^2 + px)} + q = 0$$

Completing the square for $x^2 + px$

$$\left(x + \frac{p}{2}\right)^2 - \left(\frac{p}{2}\right)^2 + q = 0$$

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Tip:

Note that the coefficient of x^2 in the above form is 1.

So what happen if the coefficient of x^2 is not 1?

Then divide both sides of the equations by the coefficient of x^2 such that this will become 1.

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1.2 WORKED EXAMPLE 2 (SOLVING QUADRATIC EQUATION BY COMPLETING THE SQUARE)

Solve the following quadratic equations, giving your answers correct to 2 decimal places.

(i) $x^2 + 6x - 5 = 0$

(ii) $x^2 - 5x + 3 = 0$

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1.2 PRACTICE NOW**QUESTION 1**

Express each of the following expressions in the form $(x+a)^2 + b$.

(i) $x^2 + 6x$

(ii) $x^2 - 3x$

(iii) $x^2 + \frac{4}{5}x$

(iv) $x^2 - 2\frac{1}{2}x$

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QUESTION 2

- (i) If $x^2 + 10x + m$ is a perfect square, find the value of m .
- (ii) Hence, solve the equation $x^2 + 10x + m = 0$ giving your answers correct to 2 decimal places.

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QUESTION 3

- (i) If $25x^2 - 30x + k^2$ is a perfect square, find the positive value of k .
- (ii) Hence, solve the equation $25x^2 - 30x + k^2 = 5$ giving your answers correct to 2 decimal places.

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QUESTION 4

Solve the following equations by completing the square, giving your answers correct to 2 decimal places.

(i) $x^2 + 3x + 6 = 0$

(ii) $x^2 - 5x - 3 = 0$

(iii) $5x - x^2 + 4 = 0$

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QUESTION 5

(i) Express $x^2 - 6x - 13$ in the form $(x - a)^2 - b$, where a and b are integers.

(ii) Hence, solve the equation $x^2 - 6x - 13 = 3$ giving your answers correct to 2 decimal places.

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QUESTION 6

- (i) Express $x^2 + 4x - 6$ in the form $(x + a)^2 + b$ where a and b are integers
- (ii) Hence, solve the equation $x^2 + 4x - 6 = 0$.

QUESTION 7

- (i) Express $x^2 - 13x - 9$ in the form $(x + a)^2 + b$.
- (ii) Hence solve the equation $2x^2 - 26x - 18 = -98$.

QUESTION 8

- (i) Express $6 - 2x - x^2$ in the form of $p - (x - q)^2$, where p and q are constants.
- (ii) Hence, solve the equation $6 - 2x - x^2 = 0$ giving your answers correct to 2 decimal places.

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QUESTION 9

- (i) Write $2x^2 + 10x - 1$ in the form of $a(x + h)^2 - k$.
- (ii) Hence, solve $2x^2 + 10x - 1 = 0$.

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